COMPUTER MODELS

USED BY THE

ASSISTANT CHIEF OF STAFF

STUDIES AND ANALYSES

HEADQUARTERS UNITED STATES AIR FORCE

(AF/SA)

AUG 1979

The purpose of this document is to provide a listing of computer simulation models used by Headquarters USAF, Studies and Analyses. The ACS Studies and Analyses provides to the Air Force and DOD timely illumination and visibility of the force structure issues which bear on defense posture readiness decisions. Ultimately, illumination of such issues provides the basis for DOD decisions today regarding the allocation of money and other resources for national defense force structures of the future. Computer simulation modeling is one of the analytical techniques used by the analyst to gain insight into the myriad of detailed relationships effecting force structure and force readiness decisions.

This document has been reviewed by Air Force Office of Information Security and cleared for public release.

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SECTION A

TACTICAL

NAME: VARIABLE AIRSPEED FLIGHT PATH GENERATOR (BLUE MAX)

DESCRIPTION: The BLUE MAX model generates a variable speed flight path suitable for use as an input into our AAA and SAM attrition models. Each aircraft is entered with its weight, wing area, lift and drag coefficients stated as a function of mach number. Thrust is entered as a function of mach and altitude. Five types of maneuvers--(1) navigation, (2) base, (3) roll in/dive, (4) pull-off, and (5) recovery/jink legs--are included in the model. The methodology is based on the assumptions that the pilot is able to exercise control of only three variables: pitch, roll, and power. The rate of change and magnitude of these variables is a function of the type of maneuver encountered. The model treats the aircraft as a point mass, solves for the lift, drag, and thrust to determine the three orthogonal accelerations in the body axis and then transform them into an inertial reference. These inertial accelerations are then used to update the velocity and position of the aircraft.

BLUE MAX was developed by the Assistant Chief of Staff, Studies and Analysis (AF/SA), Headquarters United States Air Force and is used in conjunction with attrition models in the study of aircraft survivability.

COMPUTER INFORMATION: BLUE MAX was written in FORTRAN Y for the GE-635 with 24K storage but resides on MULTICS. The average time for building a single flight path is about 30 minutes when using an interactive operation.

DOCUMENTATION: Limited documentation is available in AF/SAGF.

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NAME: DADENS-C^2 - DIVISIONAL AIR DEFENSE ENGAGEMENT SIMULATION - COMMAND AND CONTROL

DESCRIPTION: The DADENS-C^2 model was developed for the US Army Air Defense School, Fort Bliss, Texas from the CADENS IV model in 1975. It has been designed to simulate the operation of alternative air defense command and control systems in a conventional or nuclear theater conflict. The theater air defense command and control hierarchy simulated includes dynamic AWACS, CRC's, CRP's, Group or Brigade AADCP's and both Army and Air Force sensors. Both offensive and defensive weapon systems are simulated with the capability to look at alternative C^3 systems and their associated communications (links and messages) and rules of engagement. The model also simulates terminal weapons such as sensors (IR, RF, visual), fighter-interceptors, SAM's, and AAA. All offensive and defensive units are represented separately including communications centers and sensors. Terrain masking and terrain following flight paths can be simulated through a conversion program which accepts the TACOS FRAG IC event tape as an input. The model is being developed to include more detail in the fighter-interceptor defense system for use as a theater air defense model capable of simulating all Allied Air Forces Central Europe forces simultaneously.

DADENS-C^2 is a three-dimensional model capable of simulating 28,665 offensive objects versus 63 defense zones consisting of 444 defense entities (C^2 sites, sensors, SAM's, AAA, air bases, AWACS, etc.) per zone. The model is event-stepped (with the exception of AWACS) and uses Monte Carlo techniques to determine the results of stochastic events.

COMPUTER INFORMATION: DADENS-C^2 requires an IBM 360/370 system with up to 500k bytes of core. Run time depends on the size of the problem. A recent large test case comprising 300 threat cells of aircraft and 100 defense sites resulted in 200,000 events and took approximately 6 hours of IBM 360 CPU time. It is written in FORTRAN IV (360 subroutines and over 60,000 source statements).

DOCUMENTATION: Executive Summary, User's/Planner Manuals, and Programmer Manuals are available in AF/SAGR . Functional documentation on model interactions and training case documentation will be available July 1979.

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NAME: GUNVAL V

DESCRIPTION: The GUNVAL V model is a digital computer program for evaluating the effectiveness of fighter aircraft gun systems in air-to-air combat. GUNVAL II was developed for SAGF by the General Electric Company to include the correlation effects of high firing rate guns in a terminal effectiveness model. The GUNVAL II model was then extensively modified by SAGF to include the effects of gun acceleration, reliability, projectile lethality, target maneuver bias, and tracking error.

The GUNVAL V model was specifically designed to integrate a multitude of gun and projectile performance parameters into a single measure of effectiveness: kill probability. The TAC AVENGER air combat simulation produces a tape of gun-firing opporunities which is used as an input for the GUNVAL V model. The firing opportunity tape describes the positions of the attacker and the target during the burst and gives a realistic distribution of the firing conditions expected in a duel of two airplanes for which no combat exchange data are available.

COMPUTER INFORMATION: GUNVAL V is a FORTRAN IV language program for the G-635 computer. It uses 31K words of core and consists of 16 subroutines. It contains approximately 1500 FORTRAN statements. The average run time is .02 minute per burst if only Pk information is desired. For a complete hit probability analysis the run time increases to .6 minutes per burst.

DOCUMENTATION: GUNVAL V Gun System Effectiveness Model Documentation, 17 Jun 75.

Terry, E.R., "Air-to-Air Gunnery Model and Associated Computer Program Logic for USAF/SA TAC AVENGER (GUNVAL II)," Contract F44620-73-C-0030, General Electric, Aircraft Equipment Division, Armament Systems Department, Burlington, Vermont, 12 April 1973.

NAME: PØØ1

DESCRIPTION: PØØ1 computes the single shot probability of kill (SSPK) of a target aircraft flying through anti-aircraft artillery (AAA). Aircraft attrition along an entire flight path is attained through accumulation of the SSPK's. The major portion of the program is concerned with the analysis of the various sources of random errors which influence the effectiveness of the AAA. After assessment of these errors, the vulnerable area of the aircraft is located within the total distribution of AAA trajectories, and the probability of kill is computed. PØØ1 was developed by the Air Force Armament Laboratory.

COMPUTER INFORMATION: PØØ1 is used on the MULTICS computer. There are approximately 1400 FORTRAN source statements, and the running time for some typical AAA encounters is approximately five minutes. There are twelve input cards, and the program contains several subroutines.

DOCUMENTATION: The program was documented by Armament Systems, Inc. for the JTCG/ME.

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NAME: TAC ASSESSOR

DESCRIPTION: The TAC ASSESSOR model is nearing completion of the first stage of development. TAC ASSESSOR is being developed to provide AF/SA with a large-scale, comprehensive computer simulation model for use in two-sided theater-level air and ground conflict analysis. TAC ASSESSOR presently includes offensive air support, reconnaissance, defense suppression, and ground-battle processes.

The first stage of TAC ASSESSOR development has been devoted to development of the heart of the model, the command and control system at CORPS/TACC and below. At the present time, TAC ASSESSOR is representative of the leading edge of simulation model technology in this area in that it has an explicit representation of command and control entities and processes, i.e, the cognitive, planning, communication, and directing processes of command elements are simulated in detail. These simulated command elements observe the battle by requesting intelligence information. They then assimilate that information, use that information to "understand" the battle, devise and test plans, and issue plans and directives to subordinate units. Subordinate units behave in a similar manner and incorporate the plans and directives of higher echelons in their cognitive and planning processes. At the lowest level of the command entity chain are the actual war-fighting elements. These elements are brought to engagement by the command elements. The engagements among these war-fighting elements are simulated using conventional combat simulation techniques similar to those used in TALON and TAC EVALUATOR.

TAC ASSESSOR makes extensive use of interactive graphics so that one is able to follow the processes occurring in the model. It is also possible to modify the cognitive processes of the command elements during a model run. In this way, the simulated command elements may be interactively "taught" by the console operator and adjusted so that their battle-managing behavior parallels that of their "real-world" counterparts.

Explicit representation of the command and control elements is essential to the understanding of complex interactions expected to occur among various command and control associated systems that are already in existence or being planned for the future. TAC ASSESSOR is expected to provide, for the first time, a systematic approach to study of those interactions.

COMPUTER INFORMATION: FORTRAN, event list model currently on Multics system and CDC 6400. Expected to be put on IBM 3032. 120,000 lines of source code including supporting utility systems.

DOCUMENTATION: Should be available after August 1979.

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NAME: TACTICAL AIR CAPABILITIES, AVIONICS, ENERGY MANEUVERABILITY EVALUATION AND RESEARCH (TAC AVENGER)

DESCRIPTION: The TAC AVENGER Model is a digital computer simulation of two aircraft in a close-in maneuvering air duel. In this simulation, each aircraft maneuvers in three dimensions; each pilot reacts on a second-by-second basis to the maneuvers of the opponent; and each pilot expends ordnance against the other aircraft as opportunities occur. The aircraft and weapons performance are described in detailed engineering data. The individual aircraft tactics are selected from a range of reasonable choices based upon the tactical situation, the relative performance capability of the aircraft, and pilot preferences. These individual pilot preferences were derived from empirical, real-world data and are selected using a random selection of avionics, energy maneuverability, and weapons to fighter effectiveness.

TAC AVENGER development was initiated in 1967 by the Assistant Chief of Staff, Studies and Analysis, Headquarters USAF. The model is based on the North American FANTAC Model.

COMPUTER INFORMATION: TAC AVENGER is a FORTRAN IV language program for the G-635 computer system. The model uses 44K words of core with 94 routines having 19000 source statements. The average 635 run time is 2.5 minutes for each 5 minutes of simulation.

DOCUMENTATION: The following documents were originally used for basic reference:

NA-66-765, Air-to-Air Combat Simulation Model, 15 Jul 1966
NA-66-IV, Vol I, FANTAC, 3 Oct 1966
NA-66-IV, Vol II, FANTAC, 3 Oct 1966
NA-66-1120, FANTAC, 3 Oct 1966
NA-68-729, FANTAC Radar Model, 30 Sep 1968
NA-68-1022, Improved FANTAC Radar Model, 20 Dec 1968
The maneuver subroutine are being documented by Rockwell International Corp.

Additional information on modifications is available in AF/SAGF.

NAME: TAC BRAWLER

DESCRIPTION: TAC BRAWLER is a monte carlo computer simulation intended to model multiple aircraft air combat. Each simulated pilot owns his own mental model in which he may observe changes in his environment and exchange message traffic with other members of his flight. The primary inputs to the mental model are from simulated visual and radar observations. Each pilot's decison as to what course of action (maneuver) to perform is made using a technique called "value-driven decision making." This technique allows the pilot to consider numerous options for his next maneuver, predict the consequences of employing that maneuver for the near term, appropriately weight the results of such a maneuver, then select the maneuver which scores the highest.

TAC BRAWLER has evolved from the TAC FLIGHT model originally developed by General Research Corporation. The present contractor is Decision-Science Applications, Inc. The model is currently in the experimental/developmental growth stage.

COMPUTER INFORMATION: TAC BRAWLER is coded in both FORTRAN IV and PL/I. The model is installed on the Multics System and uses a quota of approximately 3500 pages. The program run time is approximately 30 seconds of CPU usage for 150 seconds of simulated one-versus-one combat.

DOCUMENTATION:

Gorman, G.F. TAC FLIGHT A Value-Driven Multi-Aircraft Simulation for Analysis of Close Air Combat. Final Report. McLean, Va. General Research Corporation, Nov 1977.

The Simulation of Cooperative Air Combat in TAC BRAWLER. Unsolicited Proposal DSA/P-78-26. Arlington, Va. Decision-Science Applications, Inc., 19 Jan 1978.

Kerchner, R.M. and Gorman, G.F. A Command, Control, and Communications Model for TAC BRAWLER. Final Report and Software Documentation, Report No. 53. Arlington, Va. Decision-Science Applications, Inc., 14 May 1978.

Lucas, G.L., _et al_. _Value-Driven Decision Theory: Application to Combat Simulations_. Final Report No. DSA-67. Arlington, Va. Decison-Science Applications, Inc., July 1978.

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NAME: TAC CONTROLLER

DESCRIPTION: TAC CONTROLLER is a large-scale simulation of tactical air warfare which, in different versions, relates the parameters of the Tactical Air Control System (TACS) to the effectiveness of the Tactical Air Forces in a non-benign electronic environment. It has been designed for ease in making trade-off studies and sensitivity analyses. TAC CONTROLLER was designed to measure the impact of command and control on the conduct of air warfare. Specifically, it modelled the relationships between the parameters of the 407L/412L/AWACS as deployed in USAFE and the performance parameters of the counter air mission.

Modelling of the sequence of events occuring within the command and control system is achieved through the use of a network. This representation is maintained by the use of nodes and links to symbolize personnel, equipment, and communication links. Messages portray the flow of information between these various entities. Resources are used to provide physical limitations to the capabilities of any element. Times, as well as priorities, constraints, and probabilities, can be associated with these nodes and links. Networks can be studied as a complete unit by arranging their constituents into groups, or by looking at each piece individually. Much of the information to be gained by the use of this network is derived from the queus which occur when some part of the system is overloaded. The model is being replaced by DADENS C^2 for theater air defense studies.

COMPUTER INFORMATION: The TAC CONTROLLER program deck of 10,000 FORTRAN cards contains 27 list processing subroutines, 34 basic subroutines, and 76 specialized subroutines. The simulator represents the tactical air control system with a 126 node, 137 link multi-level network using 47 resources. Execution of these routines on MULTICS handles up to 2,000 aircraft in a simulated period of over 4 hours with actual computer time of less than 30 minutes.

DOCUMENTATION: Reports describing the model, a User's Manual and logic flow documentation are available in AF/SAGR.

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NAME: TAC EVALUATOR

DESCRIPTION: TAC EVALUATOR is a dynamic, event-sequenced, expected value simulation. Lanchester equations are used to resolve the ground combat engagements. The model can reflect breakthrough tactics; single, double and vertical envelopments; and employment of tactical air.

The TAC EVALUATOR model is designed to show the effect of various combinations of tactical air weapons and support systems on the outcome of a dynamic, corps level ground battle.

The model keeps track of movement, strength, and attrition of up to 200 ground units, including both engaged and second-echelon units. It generates demand for close-air-support and interdiction missions, allocates available aircraft in either interactive or automatic mode, does targeting, and computes strike results and air losses on an aggregate basis.

Individual unit movement and timing permit freedom of maneuver in any direction. Offensive unit movement is simulated at engaged or approach march velocities with delays in movement of ground forces as a result of air strikes.

The model can be run in either an automatic or interactive mode. The automatic mode is used for studies in which only one condition or strategy is varied for each case to be analyzed. Input data, such as force size, reconnaissance plan, and weapons effectiveness, are initialized and the model essentially runs as a batch process until the declared end-of-war time.

Interactive operation allows investigation of the dynamics of battlefield operations. It is used to reveal dependencies on doctrine and operational concepts without imposition of a fixed set of decision rules.

An extensive graphics package is available to assist the user or a battle staff's interactive planning of reconnaissance or air strikes.

COMPUTER INFORMATION: The model is coded in standard FORTRAN IV and is currently operational on the Honeywell 6180 (MULTICS) computer, for use by AF/SAG and the Cyber 74 computer, used by TFWC/SA, Nellis AFB, Nevada. The MULTICS version contains over 12,000 FORTRAN instructions in 140 subroutines.

Running the model for 5 days of war takes 1 to 2 hours (15-30 minutes on the Cyber 74) in the automatic mode. Running fully interactive requires 1/4 real time.

DOCUMENTATION: General information manual and program descriptions for the routines are available in AF/SAGR.

NAME: TAC GLADIATOR

DESCRIPTION: TAC GLADIATOR is an expected value, force on force, campaign level, air battle model. The model objective is to examine effectiveness -- between fighter/attack systems and over time -- as measured against an explicit threat. The model is designed as a day-to-day simulation of an air battle over a battlefield area and over enemy airfields. The six missions included are: Battlefield Attack (BFA - direct and indirect support of ground forces), Local Air Defense (LAD - protecting BFA), Air Base Attack (ABA - deep penetration strikes), Escort (ESC - air-to-air protection for ABA), and Air Base Defense (ABD - defending air bases against attack). Air-to-air engagements including both beyond visual range and close-in duels with 4:1, 3:1, 2:1 and 1:1 matchings.

Ground targets on an air base that are played dynamically are aircraft in the open, aircraft shelters, and maintenance shelters. The results of these targets being destroyed are related to loss of maintenance resources, ability to repair aircraft and then to sortie generation capability. Other ground targets played include GCI and SAM sites.

TAC GLADIATOR has been developed by the Assistant Chief of Staff, Studies and Analysis (AF/SA), Headquarters United States Air Force. The development has been strictly an "in house" effort to produce a highly aggregate, fast-running air battle effectiveness model.

COMPUTER INFORMATION: The TAC GLADIATOR model is written in the FORTRAN IV language for use on the IBM 3032 computer. The model contains one main program and 19 subroutines for approximately 1500 source language statements. The running time is approximately 20 seconds CPU time for a ten-day war.

DOCUMENTATION: Documentation of TAC GLADIATOR is available in AF/SAGF.

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NAME: TAC INTERDICTOR

DESCRIPTION: The TAC INTERDICTOR model is being developed to gain insight into the dynamic interactions and effectiveness of interdiction operations.

TAC INTERDICTOR is a very detailed, deterministic, computerized-map-exercise simulation model, based on systems dynamics concepts. Elements in the model include: 2 types of aircraft; 5 types of ordnance mission planning, command and control; aircraft repair and maintenance; resource supply/logistics/maintenance; dynamic priority targeting; 6 ground battle resources-tanks, APC, ARTY, tank ammo, ARTY ammo, and POL; fixed and moving targets; LOCs; ground battle attrition; weapons effects; aircraft attrition; and weather.

The model is under development by the Directorate of Concepts and Analyses, Hq U.S. Air Force and has been used to develop close air support/interdiction/ground battle relationship curves and interdiction logic for the WARRIOR and CASM models.

COMPUTER INFORMATION: Computer language - FORTRAN Y; computer types - G-635.

DOCUMENTATION: A compilation draft of the User's Guide documentation is available in AF/SAGF.

NAME: TAC LANCER

DESCRIPTION: TAC LANCER is a digital computer program for evaluating the effectiveness of air-to-air missiles in maneuvering combat. The baseline TAC LANCER model was developed by SAGF to provide endgame missile effects in TAC AVENGER II. The model is used both on-line with TAC AVENGER II and off-line to assess missile capabilities. Dynamics Research Corporation (DRC), under contract with SAGF, has extended the model logic to include options for Thrust Magnitude Control (TMC) and Thrust Vector Control (TVC). In addition, DRC has modified protrayal of drag arrays, missile dynamics, and body rates.

The model is specifically designed to provide missile Pk in a maneuvering environment. TAC AVENGER II firing opportunity tapes describe the positions of attacker and target. Missile flyout is continued through fusing and fragment impact. Pk's are further attenuated by modifiers for launch, guide, and fuze reliability.

COMPUTER INFORMATION: TAC LANCER is a FORTRAN IV language program for the G-635 computer. The model uses 32K words of core with 50 routines having 2000 source statements. The program run time is approximately 30 seconds per missile shot.

DOCUMENTATION: Optimal Guidance and Thrust Magnitude Control for Air Launch Tactical Missiles 15 Sept 77.

Users Manual for Optimal Guidance and Thrust Magnitude Control Simulation Program-Vol I and II 31 Oct 77.

NAME: TAC RANGER

DESCRIPTION: The TAC RANGER computer program is used in fighter aircraft performance studies to establish range and payload for various combat missions. Combat range/radius is an important performance parameter for the fighter aircraft. It establishes the boundary of the region in which a given fighter aircraft can operate. Payload (missiles and bombs) carried by a fighter aircraft is another important performance parameter. It determines the lethality of a fighter as a weapon system. However, range and payload are conflicting performance parameters in that an increase in payload results in a decrease in the maximum combat radius. Thus the TAC RANGER computer program was developed to conduct combat range/radius and payload trade-off studies.

COMPUTER INFORMATION: TAC RANGER is a FORTRAN IV language program for the G-635 computer. It uses 43K words of core and consists of 46 subroutines. It contains approximately 3800 FORTRAN statements. The average run time is three minutes for each flight profile.

DOCUMENTATION: The TAC RANGER Computer Program
Vol I The Analyst Manual
Vol II User's Manual and Program Description
Vol III Source Listings and Flow Charts 26 Feb 79

NAME: TAC RESOLVER

DESCRIPTION: TAC RESOLVER is an AF/SAGF developed deterministic close air support model. The inputs include flight size, ordnance load, ordnance effectiveness per pass, target array, air defense array, per pass effectiveness of air defenses. Model maximizes the measure of effectiveness by allocating various level of defense suppression passes. Output includes targets killed, aircraft killed, and aircraft damaged.

COMPUTER INFORMATION: Program is written in FORTRAN and run time is 10 minutes for a six hour battle.

DOCUMENTATION: Not documented. Program and information available in AF/SAGF.

NAME: TAC RESOURCER

DESCRIPTION: TAC RESOURCER is a large-scale air-to-ground resource allocation computer model designed by the Control Analysis Corporation, Palo Alto, California. TAC RESOURCER will simultaneously consider up to 30 different aircraft and 100 different munitions for optimal allocation to 50 different targets. Sortie allocation is determined by using a linear programming technique. Four objective functions may be used singly or sequentially in any combination. The objective functions are: (1) maximize "military worth", (2) minimize total sorties, (3) minimize total cost, and (4) minimize total aircraft losses. The sortie allocation process can be constrained by target destruction, weather, attrition, and availability of sorties, munitions budget, existing munition stockpiles and operational factors. Extensive sensitivity ranging analysis on major parameters is also available.

TAC RESOURCER development was initiated initiated in 1973 by the Assistant Chief of Staff, Studies and Analysis (AF/SA), Headquarters United States Air Force. The TAC RESOURCER computer system was completed in February 1976.

COMPUTER INFORMATION: The systems' computer programs are written in FORTRAN H for use on the Air Force IBM 3032 computer.

DOCUMENTATION: Documentation is available in AF/SAGF.

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NAME: TAC SELECTOR (SELECT)

DESCRIPTION: The TAC SELECTOR computer program is the third of several tandem computer programs (see TAC WEAPONEER and TAC SURVIVOR) used to derive alternative stockpiles of non-nuclear air-to-ground ordnance for USAF tactical fighter forces in a specified theater of conflict. Using expected kill per sortie factors obtained from TAC WEAPONEER, the program selects preferred weapons for various aircraft-target-weather bands on the basis of either least total cost or least sorties to kill the target. This data may be used as input to two other programs: HEAVY ATTACK, developed by OSD(PA&E) which allocates sorties and calculates a munitions stockpile, or TAC RESOURCER, a newer more flexible large-scale resource allocation model.

TAC SELECTOR was developed by the Assistant Chief of Staff, Studies and Analysis (AF/SA), Headquarters United States Air Force, as part of the major designated study entitled: "An Improved Methodology for Determining Alternative Mixes of Air-to-Ground Munitions, and an Application of the Methodology to the United States Air Forces in Europe (U) (SABER MIX - ALPHA)," initiated 1 May 1971.

COMPUTER INFORMATION: TAC SELECTOR was written for the G-635 computer system in the FORTRAN Y programming language. The model uses 47K words of G-635 core storage and consists of one control routine and 8 subroutines. There are approximately 700 FORTRAN Y source statements in the model. The average processing time on the G-635 is approximately one minute for each aircraft in the data base.

DOCUMENTATION: TAC SELECTOR documentation is available in AF/SAGF.

NAME: TAC SURVIVOR

DESCRIPTION: The TAC SURVIVOR computer program is the second of several tandem computer programs (see TAC WEAPONEER and TAC SELECTOR) used to derive alternative stockpiles of non-nuclear air-to-ground ordnance for USAF tactical fighter forces in a specified theater of conflict. The program uses the output from the TAC WEAPONEER program as the basis for attrition calculations. The program accounts for enroute, outbound and terminal area attrition due to ground based defenses (missiles and artillery) only. The output data are "expected-kill-per-sortie" and "expected-losses-per-sortie" factors for each aircraft-weapon-target combination desired.

TAC SURVIVOR was developed be the Assistant Chief of Staff, Studies and Analysis (AF/SA), Headquarters United States Air Force, as part of the major design study entitled: " An Improved Methodology for Determining Alternative Mixes of Air-to-Ground Munitions and an Application of the Methodology to the United States Air Forces in Europe (U) (SABER MIX - ALPHA)" initiated 1 May 1971.

COMPUTER INFORMATION: TAC SURVIVOR was written for the G-635 computer system in the FORTRAN Y programming language.

DOCUMENTATION: TAC SURVIVOR documentation is available in AF/SAGR.

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NAME: TAC TURNER

DESCRIPTION: TAC TURNER is an event simulation model which simulates aircraft turn-around activities on a tactical airbase. The model determines surge sortie generation capabilities for various tactical aircraft when constrained by airbase resources (e.g., maintenance, manpower, spare parts, shelters, POL, munitions, aircrews). Turn-around functions such as arming/dearming, battle damage repair, unscheduled maintenance repair, cannibalization, attrition, refueling, weapons loading, and WRM resupply are incorporated in the model.

The maintenance data are related to aircraft Work Unit Codes (WUC). For each WUC, required inputs include: failure rates, repair times, manpower (AFSC) required to repair, probability that a spare part is required, probability that a spare part can be repaired on base, and time and resources required for shop repair. Output is variable but typically includes: sorties-generated versus time, distributions of repair and turn-around times, and in-commission rates.

COMPUTER INFORMATION: TAC TURNER was developed by AF/SA in 1975. The model was written initially in GESIM (GE 635 General Simulation compiler). G-635 applications required 41K (maximum system capability) for 10 minutes. The model was converted to the more flexible General Purpose Simulation System (GPSS) language and adapted to the IBM 370 computer. Typical operation with the IBM 370 requires 256K bytes of core and two minutes of CPU.

DOCUMENTATION: Copies of formal documentation and information on program opeation are available in AF/SAGF.

NAME: TAC WARRIOR

DESCRIPTION: The model simulates the allocation of tactical aircraft to various roles a[illegible] missions, including close air support, barrier air patrol, offen[illegible] counter-air, defensive counter-air, interdiction, electron[illegible] warfare, and other missions of a theater campaign. The basic premise is that TAC Air's primary role is support of the ground battle. The Red and the Blue forces can perform the missions simultaneously with both employing up to four different airfield attack or interdiction aircraft, four different air defense aircraft, three Close Air Support (CAS) aircraft, Barrier Combat Air Patrol (BARCAP) aircraft, and three different airborne interceptors in the area of the FEBA.

In modeling the scenario, the model accounts for both visual and radar search capabilities of the fighter aircraft as well as their speed, endurance, and air-to-air armament. The vectoring and warning capabilities of GCI and AWACS systems are accounted for in the model. The air-to-air duels are modeled as either 4-on-1, 3-on-1, 2-on-1, or 1-on-1 duels. The number of duels of each type is treated as a random variable dependent upon force allocations and commitment tactics which determine the total number of aircraft that are engaged as a function of time.

To a large extent, the TAC WARRIOR model depends on a system of one-on-one models for its inputs. The one-on-one models are micromodels with high resolution. The integration of each of these micromodels with TAC WARRIOR is the keystone of the methodology.

In the TAC WARRIOR model, the close air support mission effectiveness and attrition are based upon attacking targets in the forward edge of the battle area. The effectiveness and attrition continually change depending on the presence of electronic warfare support, the opposing level of surface-to-air defense, and target availability. The barrier combat air patrol (BARCAP) mission protects the close air support aircraft from the opposing air threat. The BARCAP's level of effectiveness depends on the aircraft avionics and capabilities in air-to-air engagements. The offensive counterair missions are targeted against airbases, ground control intercept sites, and surface-to-air missile systems. Defensive counterair is responsive to the opposing offensive counterair missions. Associated with defensive counterair is the ground control intercept (GCI) system, the availability of an Airborne Warning and Control System, and surface-to-air systems including antiaircraft artillery. Interdiction missions are targeted against reserves and supplies. The

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availability of aircraft to perform each mission is dependent upon an airbase capability to generate ready aircraft. This generation process varies with the level of spare parts, the availability of maintenance personnel, and the level of airbase destruction created by airbase attacks.

A unique feature of TAC WARRIOR is the airfield portion of the model. It keeps track of two different classes of shelters, aircraft in shelters, and in the open, five different kinds of munitions, POL, 35 different spare parts, and 12 different maintenance personnel types. These resources, together with the times necessary to perform the various maintenance and service functions are used to generate sorties. If the airfield is attacked, all the resources are at risk, the damage done to the airfield is a function of how it is populated at the time of the attack. The time necessary to perform the maintenance and service tasks increases as the resources are consumed or destroyed by air attack. TAC WARRIOR was developed in 1974-1975 by the Assistant Chief of Staff, Studies and Analyses (AF/SA), Headquarters United States Air Force.

The model has evolved through five major versions since its initial development. Version one capabilities are listed above. Version five has added to version one capability to: provide two sided ground battle demand in up to 12 ground sectors on each side; offer better CAS resolution through six additional CAS loops and; revised and modernized Air-to-Air methodology Versions 1 through 4, although no longer active are retained in a computor facility archive.

COMPUTER INFORMATION: All versions of TAC WARRIOR are written in FORTRAN IV programming language, and can be operated on the IBM 360/370 computers. Version 5 contains approximately 140 subroutines and 17000 source statements. This version requires 800K bytes of core and a 1 day war is run in 10-15 minutes of CPU time on the IBM 370.

DOCUMENTATION: Version 1 has been formally documented. Copies of documentation and information on expanded TAC WARRIOR capabilities are available in AF/SAGF.

2

NAME: TAC WEAPONEER

DESCRIPTION: The TAC WEAPONEER computer program is the first of several programs (see TAC SELECTOR and TAC SURVIVOR) used to derive alternative stockpiles of non-nuclear air-to-ground ordnance for USAF tactical fighter forces in a specified theater of conflict. Using the open-end methods published in the "Joint Munitions Effectiveness Manual," TAC WEAPONEER computes the expected kills per sortie for each aircraft-weapon-target combination desired. Computations for up to 100 targets, 10 aircraft, and 60 weapon/delivery conditions can be made during a single run.

TAC WEAPONEER was developed by the Assistant Chief of Staff, Studies and Analysis (AF/SA), Headquarters United States Air Force. It is based largely on its predecessor, WEAPON, which was developed by the Research Division, Operations Analysis, Vice Chief of Staff, Headquarters United States Air Force.

COMPUTER INFORMATION: TAC WEAPONEER was written for the G-635 computer system in the FORTRAN Y programming language. The model uses 37K words of G-635 core storage and consists of one control routine and 37 subroutines. There are approximately 2000 FORTRAN Y source statements in the model. The average processing time on the G-635 is approximately 4.0 minutes.

DOCUMENTATION: TAC WEAPONEER documentation is available in AF/ SAGR.

2 4 JUL 1979

NAME: TAC ZINGER 2

DESCRIPTION: The TAC ZINGER 2 model is a classified many-on-one computer simulation of a radar surface to-air missile (SAM) system. The model includes interaction of a maneuvering aircraft flight path with a guided missile flight path. The interaction includes considerations of target radar signature, command generation, guidance dynamics, missile kinematics, tracking uncertainties, and proximity fusing. The model has the capability to evaluate electronic countermeasures, and it will accommodate radar SAMs using a command guidance principle. This model differs from other TAC ZINGERS in that each simulates different SAM systems.

COMPUTER INFORMATION: TAC ZINGER 2 is written in FORTRAN and it requires approximately 35,000 words of memory. A one-on-one simulation will require approximately 30 seconds of running time.

DOCUMENTATION: The model is not yet documented.

ADDITIONAL USERS: This model has been made available to ASD, AFFDL, AFAL, FTD, Naval Weapons Support Center, AFTEC, USAFE, IDA, ADTC, General Dynamics, Rockwell, Martin Marietta, AMRL, TFWC/SA, Los Alamos Scientific Laboratory, Sandia, Naval Postgraduate School, Naval Air Systems Command, Joint Cruise Missiles Program Office, McDonnell-Douglas, Fairchild, Calspan, AF School of Aerospace Medicine, SAI, Northrop. Booz-Allen, Texas Instruments, Boeing, Grumman, AMSAA, Honeywell, and Quest.

NAME: TAC ZINGER 3

DESCRIPTION: The TAC ZINGER 3 model is a classified many-on-one computer simulation of a radar surface-to-air missile (SAM) system. The model includes interaction of a maneuvering aircraft flight path with a guided missile flight path. The interaction will include considerations of target radar signature, command generations, guidance dynamics, missile kinematics, tracking uncertainties, and proximity fusing. The model has the capability to evaluate electronic countermeasures, and it will accommodate radar SAMs using a command guidance principle. This model differs from other TAC ZINGERS in that each simulates different SAM systems.

COMPUTER INFORMATION: TAC ZINGER 3 is written in FORTRAN, and it requires approximately 35,000 words of memory. A one-on-one simulation will require approximately 30 seconds of running time.

DOCUMENTATION: The model is not yet documented.

ADDITIONAL USERS: (See TAC ZINGER 2)

10 JUL

NAME: TAC ZINGER 4

DESCRIPTION: The TAC ZINGER 4 model is a classified many-on-one computer simulation of a radar surface-to-air missile (SAM) system. The model includes interaction of a maneuvering aircraft flight path with a guided missile flight path. The interaction will include considerations of target radar signature, command generations, guidance dynamics, missile kinematics, tracking uncertainties, and proximity fusing. The model will have the capability to evaluate electronic countermeasures, and it will accommodate radar SAMs using a command guidance principle This model differs from other TAC ZINGERS in that each simulates different SAM systems.

COMPUTER INFORMATION: TAC ZINGER 4 is written in FORTRAN, and it requires approximately 25,000 words of memory. A one-on-one simulation will require approximately 30 seconds of running time.

DOCUMENTATION: The model is not yet documented.

ADDITIONAL USERS: (See TAC ZINGER 2)

10 JUL 1979

NAME: TAC ZINGER 5

DESCRIPTION: The TAC ZINGER 5 model is a classified many-on-one computer simulation of a radar surface-to-air missile (SAM) system. The deterministic model includes interaction of a maneuvering aircraft flight path with a guided missile flight path. The interaction includes considerations of target radar signature, missile seeker dynamics, guidance dynamics, missile kinematics, and proximity fusing. The model has the capability to evaluate electronic countermeasures, and it accommodates semiactive radar missiles using proportional navigation. This model differs from other TAC ZINGERS in the type of SAM system simulated.

COMPUTER INFORMATION: TAC ZINGER 5 is written in FORTRAN, nd it requires approximately 34,000 words of memory. A one-on-one simulation requires approximately 30 seconds of running time.

DOCUMENTATION: The model is not yet documented.

ADDITIONAL USERS: (See TAC ZINGER 2)

24 JUL 1979

NAME: TAC ZINGER 6

DESCRIPTION: The TAC ZINGER 6 model is a classified many-on-one computer simulation of a radar surface-to-air missile (SAM) system. The model includes interaction of a maneuvering aircraft flight path with a guided missile flight path. The interaction includes considerations of target radar signature, missile seeker dynamics, guidance dynamics, missile kinematics, tracking uncertainties and proximity fusing. The model has the capability to evaluate electronic countermeasures, and it accommodates semiactive radar missiles using proportional navigation. This model differs from other TAC ZINGERS in the type of SAM system simulated.

COMPUTER INFORMATION: TAC ZINGER 6 is written in FORTRAN, and it requires approximately 34,000 words of memory. A one-on-one simulation requires approximately 30 seconds of running time.

DOCUMENTATION: The model is not yet documented.

ADDITIONAL USERS: (See TAC ZINGER 2)

NAME: TAC ZINGER 8

DESCRIPTION: The TAC ZINGER 8 model is a classified many-on-one computer simulation of a radar surface-to-air missile (SAM) system. The model includes interaction of a maneuvering aircraft flight path with a guided missile flight path. The interaction includes considerations of target radar signature, command generations, guidance dynamics, missile kinematics, proximity fusing, and radar tracking uncertainties. The model will have the capability to evaluate electronic countermeasures, and it accommodates radar SAMs using a command guidance principle. This model differs from other TAC ZINGERS in that each simulates different SAM systems. Also, this model has an optical tracking mode.

COMPUTER INFORMATION: TAC ZINGER 8 is written in FORTRAN and it requires approximately 35,000 words of memory. A one-on-one simulation will require approximately 30 seconds of running time.

DOCUMENTATION: The model is not yet documented

ADDITIONAL USERS: (See TAC ZINGER 2)

 30 JUL 1973

NAME: TAC ZINGER 10

DESCRIPTION: The TAC ZINGER 10 model is a classified many-on-one computer simulation of a radar surface-to-air missile (SAM) system. The model includes interaction of a maneuvering aircraft flight path with a guided missile flight path. The interaction includes considerations of target radar signature, missile seeker dynamics, guidance dynamics, missile kinematics, tracking uncertainties, and proximity fusing. The model has the capability to evaluate electronic countermeasures, and it accommodates semiactive radar missiles using proportional navigation. This model differs from other TAC ZINGERs in the type of SAM system simulated.

COMPUTER INFORMATION: TAC ZINGER 10 is written in FORTRAN, and it requires approximately 34,000 words of memory. A one-on-one simulation requires approximately 30 seconds of running time.

DOCUMENTATION: The model is not yet documented.

ADDITIONAL USERS: (See TAC ZINGER 2)

NAME: TAC ZINGER 11

DESCRIPTION: The TAC ZINGER 11 model is a classified many-on-one computer simulation of a radar surface-to-air missile (SAM) system. The model includes interaction of a maneuvering aircraft flight path with a guided missile flight path. The interaction includes considerations of target radar signature, missile seeker dynamics, guidance dynamics, missile kinematics, tracking uncertainties, and proximity fusing. The model has the capability to evaluate electronic countermeasures, and it accommodates semiactive radar missiles using proportional navigation. This model differs from other TAC ZINGERs in the type of SAM system simulated.

COMPUTER INFORMATION: TAC ZINGER 11 is written in FORTRAN, and it requires approximately 34,000 words of memory. A one-on-one simulation requires approximately 30 seconds of running time.

DOCUMENTATION: The model is not yet documented.

ADDITIONAL USERS: (See TAC ZINGER 2)

24 JUL 1979

NAME: IR SAM SIMULATION (TAC ZINGER 79)

DESCRIPTION: The TAC ZINGER 79 model is a many-on-one computer simulation of infrared guided air defense missile systems. The deterministic model includes interaction of a maneuvering aircraft flight path with a guided missile flight path. The interaction includes considerations of target infrared signature, atmospheric attenuation, seeker sensitivity, guidance dynamics, missile kinematics capabilities, and target vulnerable area. It also will evaluate flare and ECM countermeasures against the missile threat.

The three degree of freedom model is an improved version of the US Army Missile Command model, "Three-Dimensional Air Defense Kinematic Launch and Intercept Boundary Computer Program." The five degree of freedom model was developed by AF/SAGF under the direction of the Assistant Chief of Staff, Studies and Analysis (AF/SA), Headquarters United States Air Force. Responsibility for operation of TAC ZINGER 79 resides with AF/SAGF (SABER STRIKE).

COMPUTER INFORMATION: The model consists of 3,000 source statements requiring 35,000 words of core storage and is exercised on the multics computer. The running time for the program varies from 10 minutes to several hours depending upon the scope of the analysis.

DOCUMENTATION: The SABER ARMOR - CHARLIE report contains a general description of methodology used in TAC ZINGER 79. Additional documentation in the form of a Users Manual and an input/output description is available in AF/SAGR.

ADDITIONAL USERS: (See TAC ZINGER 2)

NAME: TACTICAL AIR COMMAND AIRCRAFT PROFILER (TACAP)

DESCRIPTION: The TACAP model is a digital computer program that provides users with a fast and flexible tool for developing information for refuelable tactical aircraft. The TACAP model simulates the flight of an aircraft cell by computing fuel consumed, time and distance between checkpoints, generating refueling points and corresponding abort routes and giving consideration to climbs and descents, climatological effects and changes in tanker-receiver ratio enroute.

COMPUTER INFORMATION: TACAP is written in COBOL and is operational on the WWMCCS system. Running time is about 1 minute and requires 52K core locations.

DOCUMENTATION: Documentation is available in AF/SAMC.

NAME: TACOS II/AF4 - TACTICAL AIR DEFENSE COMPUTER OPERATIONAL SIMULATION (AIR FORCE MODIFIED)

DESCRIPTION: The TACOS II/AF4 model provides an event-by-event simulation of interactions between individual penetrators, individual ground-based air defense elements, terrain, and Airborne interceptors. It represents interactions which occur between a large deployment of air defense systems and a large attack of conventional aerial threat vehicles over a Field Army area. The defense deployment may consist of any mixture of SAM systems, AAA systems, and AI's. The attack may consist of a mix of aircraft and missiles. Each air defense fire unit and each aerial threat vehicle is represented separately. TACOS II utilizes a detailed digitized terrain file to provide a realistic environment for the battle. Terrain masking and terrain following flight paths are represented. ECM includes the effects of stand-off, escort, and self-protection jamming. Output includes both a history of all combat activities summaries of the ground-based air defense engagements, and a Air-to-Air battle summary.

TACOS II/AF4 was developed by commercial contract for the Army Combat Developments Command and used for planning of air defenses for the Central European Region in 1967. It was adapted by an Air Force study group at Eglin AFB for study of defense suppression in 1971. It is used by the SABER COUNTER, and SABER COMMAND study groups in AF/SAGR.

COMPUTER INFORMATION: TACOS II/AF4 requires an IBM 360 or 3032 system with up to 820K bytes of core. AF/SAMC runs are made on the IBM 3032 at AFDSC. A complete run requires between 5 minutes and 5 hours on an IBM 360/75 depending on the size of the problem. The run time for an AF/SAGR case employing 255 defensive units and 192 penetrators amounted to approximately 30 minutes. Ten replications of each variation require about 25 percent of the time required for the first run. TACOS II/AF4 is written in FORTRAN IV (500 subroutines). There are over 100,000 source statements.

DOCUMENTATION: An Input Manual and User's Manuals are available in AF/SAGR.

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NAME: VISUAL DETECTION MODEL

DESCRIPTION: The Visual Detection Model is available in two modes. In one mode the probability of detection of ground targets is computed for an aircraft flying straight and level. The aircraft altitude and ground speed are inputs along with search area radius, target area, visibility, and sky-to-ground brightness ratio. In the second mode, the probability of detection is computed for an aircraft flying an orbit around the search area. The cumulative probability of detection is computed as a function of time in the orbit.

The Visual Detection Model was developed by the Assistant Chief of Staff, Studies and Analysis (AF/SA), Headquarters United States Air Force. It is based on work reported in RAND Memo RM-5938-RM and in RM-6158/1-PR.

COMPUTER INFORMATION: The Visual Detection Model was written for the G-635 computer system in the FORTRAN IV programming language. The model uses approximately 5K words of G-635 core storage and consists of one control routine. There are approximately 100 FORTRAN IV source statements in the model. The average running time is less than one minute of processing time on G-635.

DOCUMENTATION: No formal documentation currently exists for the model as the model is being continually improved and updated. However, current informal documentation is maintained by AF/SAGF.

SECTION B

STRATEGIC

NAME: ADVANCED PENETRATION MODEL (APM)

DESCRIPTION: The APM models the employment of bombers and tankers from launch to recovery; and the response by Command and Control elements, Fighter-Interceptors and SAMs from entry to exit of the defended area. The APM logic is more detailed than most force structure models but less detailed than most end game models. In the data bank, the structure for defining the contending forces is provided. A Mission Planner develops a representative plan for the employment of bombers and tankers. The simulator wages the air battle and determines the outcome of the thousands of encounters and interactions between offensive and defensive elements.

The need for an authoritative Air Force penetration model was first expressed in November 1968 by an Air Staff group examining the various models in existence. General Ryan (VCSAF), acting on the group's recommendation, initiated the APM project in December 1968. The first application of the model in a SABER study took place in early 1973.

COMPUTER INFORMATION: The APM has been converted to run on the IBM 370/3032. Programming languages used are FORTRAN, COBOL, and ASSEMBLER LANGUAGE. The model now contains about 1400 subroutines, approximately 185,000 statements and requires a minimum of 600K core. The APM has been used in AF/SA studies with the offensive forces ranging from a few to several thousand penetrators. Mission Planner running times have varied from 30 minutes to 20 hours. The full scale air battle generally runs 6 hours.

DOCUMENTATION; The master copy is kept in AF/SAMC.

NAME: APM "BETA"

DESCRIPTION: APM "BETA" is a rapid running bomber force allocation model that operates under the Advanced Penetration Model (APM) executive and uses APM data base, data management and utilities. Mission objectives are first defined by selecting targets to strike. Bombers are then routed from launch bases to targets and then recovery bases. Tanker requirements and off-load points are computed. A strike summary shows planned damage and value extracted by target category.

COMPUTER INFORMATION: APM "BETA" runs on an IBM 360 or 3032 computer. It is written in Fortran and has the same resource requirements as the APM. Full force allocations may be run in approximately 5 minutes on an IBM 3032.

DOCUMENTATION: Formal documentation has not been completed on this recently developed model. For information contact Major Johnson, AF/SASB.

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NAME: APM MEGA

DESCRIPTION: APM MEGA is a quick-running expected value model which uses output from an APM base case to predict penetrator survivability for small perturbations about the base case. The output from APM is aggregated into six parameters which describe the offense/defense force characteristics. MEGA operates on these six parameters to predict changes in penetrator survivability for user-specified changes in the offense or defense force size and/or characteristics.

COMPUTER INFORMATION: APM MEGA is written in Fortran and is currently run on the Air Force Data Services Center Multics system, which uses a Honeywell 6880. The program comprises approximately 10 subroutines and 500 lines of code. Some peripheral code is used for data mangement, but is not directly part of APM MEGA. The routine runs extremely fast on the 6880, requiring less than 5 CPU-sec for a complete calculation.

DOCUMENTATION: A complete report, DOCUMENTATION AND ASSESSMENT OF THE APM-MEGA PROGRAM is on file in AF/SASB.

2 1 JUN 1979

NAME: ARSENAL EXCHANGE MODEL (AEM)

DESCRIPTION: The Arsenal Exchange Model is a two-sided expected value moderately aggregated force exchange model which uses several mathematical programming techniques to optimize weapons allocation. It can handle third country non-retaliatory targets, full force allocations, a variety of defenses, and force design problems. There are four types of scenarios: one-strike against military and value targets; a two-strike game, and two types of three-strike games with suboptimization problems of selecting a weapons reserve or selecting a value target reserve for the initiator's third strike. There are also three types of counterforce exchange options: a limited one-strike, a limited two-strike and a one-strike, all-out counter-force strike. The model can use weapon requirements/damage curves from NUCWAL, thereby permitting dynamic determination of numbers of targets. There is also an extensive hedging capability which allows the analyst considerable control over the allocation of weapons to targets.

COUNTER INFORMATION: The AEM is currently operating on the AFDSC MULTICS computer and is running on the CDC6600, IBM 360-65, and UNIVAC 1108 computers of other agencies. It is written in FORTRAN IV. It contains 40,000 statements, 176 subroutines, and is structured into 18 overlays to minimize core requirements.

DOCUMENTATION: Four volumes of user documentation are available in the AF/SA library. Users manual is The Arsenal Exchange Model Handbook. For AEM-HEDGE, version 79, SAI-79-215-DEN, June 1979.

24 JUL 1979

NAME: An Aggregated Conversion Model for Air Combat (COLLIDE)

DESCRIPTION: COLLIDE is an aggregated model originally designed to assess the impact of command and control on fighter-bomber conversion. The principal output of the model is interceptor probability of detection and conversion (Pdc), and the model has been used exclusively in AF/SAS to compute Pdc's for various interceptor-bomber engagement scenarios. As defined in the model, Pdc is the probability that an interceptor, which has closed to within the maximum detection range of a target, detects the target and maneuvers to a position from which air-to-air armament can be successfully employed. The model therefore concentrates on the terminal phase of interception. The model has been modified and extended so that in its present form the user may consider altitude differentials between the interceptor and the target, infrared detection and doppler radar detection as well as co-altitude radar detection. An external assistance contract to further modify COLLIDE to include ECM effects was recently completed but has not been validated.

COMPUTER INFORMATION: COLLIDE was written for the G-635 in FORTRAN IV programming language. It has been adapted for use on the G-635 time-sharing system and the IBM 3032 computer system. The program, in its present form, uses 27K words of core storage, and the average running time is five seconds.

DOCUMENTATION: Both the original COLLIDE model and the extended model are fully documented in unclassified documents on file in AF/SAMI, and AF/SASI.

24 JUL 1979

NAME: NORAD Air Defense Simulation Program (FISCHER)

DESCRIPTION: FISCHER is an event oriented, Monte Carlo simulation of a strategic defense system which interacts with an attacking bomber force. The model was developed at HQ NORAD and has been modified for AF/SAS use.

FISCHER simulates the movement of bombers and air-to-surface missiles over a spherical earth and their interaction with a surveillance network. Surveillance and detection systems include ground radars and moving AWACS stations. Interceptors are committed from bases or orbit points on a variety of intercept profiles with complete fuel monitoring, reattack and recommit logic available. End-game actions of detection, conversion, and missile kill are modeled stochastically.

COMPUTER INFORMATION: FISCHER is programmed in SIMSCRIPT II.5 and operates through CARDIN on the System A and through batch on Systems B and W. The model uses 70K words of storage and requires an average of 10 minutes per game iteration.

DOCUMENTATION: Model documentation is available in AF/SASI or NORAD/XPY.

NAME: FORCE-YEAR-TOTALS (FYT)

DESCRIPTION: FYT is a quick response computer program developed to aid in calculations of strategic force balance and future force alternatives. FYT evaluates multi-year strategic force projections against various static and quasi-dynamic measures of effectiveness (MOEs) including:

- Delivery Vehicles
- Weapons
- Equivalent Megatons
- Counter-Military Potential
- Throwweight
- Hard and Soft Target Kill Potential
- Relative Force Size

These projections include quantity of systems as well as system characteristics and weapon loadings. FYT will automatically build summary files containing the MOEs by triad element for computer graphics production. FYT also has the capability to calculate the arms control compliance of projected arsenals under user specified criteria. A maximum of 100 system types may be projected over a maximum span of 30 years.

FYT has options to examine the capability of forces for any of the following conditions:

- Total Active Inventory
- Unit Equipment
- Day-to-Day Alert or Generated Available
- Day-to-Day Alert or Generated Surviving
- Day-to-Day Alert or Generated Delivered on Target

COMPUTER INFORMATION: FYT may be executed from MULTICS interactive terminals. The source coding is written in standard FORTRAN. The computer graphics routines used with FYT are designed to take advantage of special MULTICS features.

DOCUMENTATION: Users Reference Guide to the Force Year Totals (FYT) Computer Model, SAI-78-160-DEN, Dec 15 1978, Science Applications Inc., Englewood Colorado

NAME: NUCLEAR WEAPON ALLOCATION MODEL (NUCWAL)

DESCRIPTION: NUCWAL determines the minimum number and locations of DGZs required to achieve a specified damage expectancy (DE) against a target base. Calculations are performed at the complex (i.e., target island) level. The user provides the target base and characteristics of a single weapon type.

COMPUTER INFORMATION: NUCWAL operates on both the IBM 360 and MULTICS computers. It consists of approximately 12 subroutines and 2400 source lines.

DOCUMENTATION: Rudimentary documentation is available in the Command Control Technical Center, Section C312.

24 JUL 1979

NAME: ONE STRIKE ALLOCATION GENERATOR (OSAGE)

DESCRIPTION: OSAGE is a generalized, one-strike strategic allocation model that was built especially to deal with complex geography and defense coverage factors. Specifically, it is structured to optimally allocate, using linear programming, a mixed strategic arsenal (bombers, ICBMs, and SLBMs) against a large number of individual targets which are known by their geographic location, value, and terminal defense level. Additionally, there can be a complex situation of limited-range ABM defenses (interceptors and radars) which protect certain sub-sets of the targets.

OSAGE is an analysis model developed by the Martin-Marietta Corporation under contract to the Office of Assistant Secretary of Defense (Systems Analysis). Some of the concepts evolved from the development of the Arsenal Exchange Model (AEM), also available in AF/SA.

COMPUTER INFORMATION: OSAGE has been run on IBM 360 and CDC 6400 computers. Core requirements on the IBM systems are approximately 250K Bytes and run times vary from .5 to 10 minutes.

DOCUMENTATION: The OSAGE program and documentation are available through AF/SASF.

12 JUL 1979

NAME: Rapid Production Model (RPM)

DESCRIPTION: RPM is a strategic nuclear exchange model. It was conceived, designed, and developed by the Academy for Interscience Methodology and offers the user a wide variety of choices of global representations of offense, target, and geometric basing of offense and defense systems. The current version of the program available within AF/PAC is RPM 3. This version allows for assessment of fallout damage from a nuclear attack with a variety of meteorologic data used to determine global patterns of fallout. The program currently has two aggregated representations of fallout transport and deposition. The first representation is a fit on isodose and isoinsensity patterns generated by a detailed RAND Corporation model. The second is a WSEG-NAS modified representation based on several analytic fits to theoretical and empirical data. Each representation has its own valid basis and allows for investigation of collateral population damage resulting from a nuclear attack.

COMPUTER INFORMATION: RPM 3 was originally written in CDC extended FORTRAN but converted to FORTRAN IV compatible with Honeywell 6000 systems. The program has been installed and is operating on the WWMCCS system in a batch environment. Run time and core size are scenario dependent but typically are 55K words and 2 to 8 minutes CPU time.

DOCUMENTATION: A RPM User's Manual and a RPM 3 input deck dictionary are available in AF/SASM.

NAME: STRATEGIC ARMS BALANCE EVALUATION ROUTINE (SABER)

DESCRIPTION: SABER determines the optimal strike/reserve weapon strategies for a two-sided, two-strike pure counterforce ICBM exchange. The model accepts as inputs the size and characteristics of the ICBM forces of the two opposing sides.. One side is designated the initiator of the exchange, and the other side is the retaliator. Each side uses the same measure of effectiveness which represents the difference of the initiator's force capability and the retaliator's force capability. The retaliator desires to retaliate in such a way as to make this value as small as he can, given the initiator's first strike. The initiator wishes to select a first strike/reserve strategy which will make the minimum value determined by the retaliator as large as possible. Thus, we have a two-step max-min type problem.

COMPUTER INFORMATION: SABER is an interactive FORTRAN computer program. It is currently running on the Honeywell MULTICS and IBM 370 computers.

DOCUMENTATION: The SABER User's Manual is available in AF/SASF.

NAME: SIMULATION OF PENETRATOR ENCOUNTERING EXTENSIVE DEFENSES (SPEED)

DESCRIPTION: The SPEED model is a stochastic, event-based simulation of air vehicles (and weapons) penetrating through and interacting with air defense systems. Penetrating vehicles/weapons encompass: manned aircraft, drones, airborne decoys, and various air-launched ordnance, vis., ASM and gravity bombs. Air defense systems encompass: area defenses (specifically, ground EW net, AWACS, airborne interceptors (AI), airbases, GCI stations, along with the integrating C&C structure), and point defenses (specifically integrating C&C structure), and point defenses (specifically SAM sites and AAA sites). Weapon targeting can include air-defense elements. The SPEED model is compatible with and complements the Advanced Penetration Model (APM).

COMPUTER INFORMATION: SPEED is programmed in FORTRAN IV and operates on the IBM 360. Running time for a large bomber force is from 30 min to 1 hr on IBM 360. Model is being moved to IBM 3032, which will shorten run time and/or allow larger scenarios.

DOCUMENTATION: User and Programmer documentation is available in AF/SASB.

20 JUN 1979

NAME: EVALUATION OF STRATEGIC COMMAND, CONTROL, and COMMUNICATIONS SYSTEMS (STRAT COMMAND)

DESCRIPTION: STRAT COMMAND is a methodology developed by SASC to evaluate the reliability, survivability, and effectiveness of current and future SIOP Airborne Emergency Action Message (EAM) communications systems in both a peacetime and stressed (nuclear and/or electronic warfare) environment. The methodology allows the evaluation and examination of alternatives for improvements in the SIOP Airborne EAM execution system.

The STRAT COMMAND methodology consists of the following computer simulation models:

1. The Network Status Model (NSM) is used to compute the availability of each radio link as a result of a nuclear attack and jamming, and the probability of survival of various nodes following a nuclear attack. These link availabilities and node probabilities of survival are computed as a function of time over the specified game interval.

2. The Dynamic Network Simulator (DNS), Monte Carlos the flow of a single EAM from the source node (e.g., National Command Authorities) to the forces and determines the probabilities of the forces receiving and accepting the EAM.

3. The Multi-Message Simulator (MMS) simulates the flow of multiple messages through a communications network. The messages can originate from different sources and routed according to various user-specified criteria. The MMS also simulates report-back messages from the forces. Factors such as queue sizes, node processing rates, and message priorities are simulated by the model. A routing program (MAP) is used as a driver to the MMS.

4. The Bomber Communications Model (BCM) is a program that keeps track of all bombers and tankers in flight and determines the percentage of the bomber force that receives the EAM based on viewing geometry. In addition, the BCM can be exercised in a Monte Carlo mode to calculate the expected percent of the bomber force which could receive

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the EAM considering user input aircraft reliability and survivability estimates.

COMPUTER INFORMATION: 1. The NSM requires approximately 88K storage cells (36 bits) on the G-635 computer. A case consisting of 400 links requires 30 minutes of computer time. The NSM has 246 subroutines and over 18000 source statements, and is overlayed to conserve core.

2. The DNS requires approximately 55K storage cells (36 bits) on the G-635 computer. With moderate output statistics collection requested by the user, a network containing approximately 100 nodes (9 special) and 700 links can be analyzed over 120 minutes of real time using 1000 Monte Carlo runs in less than five minutes of computer time. The DNS has 12 subroutines and approximately 1500 source statements.

3. The MMS requires approximately 100K storage cells (36 bits) on the G-635 computer for a network consisting of 30 nodes, 100 links, and 20 messages.

4. The BCM requires approximately 95K storage cells (36 bits) on the G-635 computer. A deterministic case requires two to three minutes of computer time and a Monte Carlo simulation case requires approximately one hour. The BCM has 41 subroutines and 3800 source statements.

DOCUMENTATION: A User's Manual and a Programmer's Manual for each of the STRAT COMMAND models is available.

NAME: EVALUATION OF THE EFFECTS OF ELECTRONIC COUNTERMEASURES ON STRATEGIC COMMUNICATIONS SYSTEMS (STRAT CROW)

DESCRIPTION: STRAT CROW is a computer simulation model which quantifies the effects of various types of electronic countermeasures (ECM) against digital communications links. The program models noise, continuous wave (CW), and frequency modulated (FM) jamming against frequency shift keyed (FSK) signals, and can handle M-ary, frequency hopping signals.

The computer program has been expanded to include noise, CW, and FM jamming against phase shift keyed (PSK) signals and is now in test. This capability will permit analysis of the most modern spread spectrum signalling techniques.

COMPUTER INFORMATION: The model is written in FORTRAN computer language for the CDC 6500 scientific computer and contains approximately 3000 instructions. Running time for the program is normally less than one minute. The bulk of the code has also recently been integrated into the STRAT COMMAND Network Status Model.

DOCUMENTATION: Limited documentation is available in AF/SASC.

20 JUN 1979

NAME: Airborne Radar Detection Methodology (STRAT DETECT)

DESCRIPTION: STRAT DETECT offers a method other than pure simulation for the evaluation of input factors in a study of an airborne radar barrier. A lower bound probability of detection is calculated for specified patrol length, penetrator distance from center of patrol path, and relative velocity heading. This is shown to be independent of the initial position of the patrol aircraft on the patrol path. Integration over the region of responsibility for the patrol gives an average probability of detection, which is used to determine a maximal patrol path length for various ratios of penetrator velocity to patrol velocity. This is used to determine the number of patrol aircraft required to obtain a desired probability of detection along the barrier. Strengths of this approach are the precise mathematical formulas initially available, as opposed to the successive levels of approximation (compounding error) produced by a simulation. The methodology is an extension of an Aerospace Research Laboratories' report entitled, "Optimization of Aerial Defense Patrols for Detection of Aerial Targets," number ARL 65-142.

COMPUTER INFORMATION: STRAT DETECT was written for the G-635 in FORTRAN IV, and can be run in the batch or time-share mode. The model uses 35K words of G-635 core storage, and consists of 12 subroutines. There are approximately 500 source statements in the program. The average running time is 3 minutes.

DOCUMENTATION: Limited user's documentation available from AF/SASI.

NAME: STRAT DUELER ALPHA

DESCRIPTION: The program is an ICBM-only exchange analysis tool which calculates basic measures of merit for the silo-based United States and Soviet ICBM forces. The measures of merit which are examined by the model are the number of surviving silos, reentry vehicles, megatonnage, throwweight, equivalent megatonnage, hard target kill potential, and soft target kill potential.

All measures of merit are calculated for three distinct scenarios. The scenarios are one reentry vehicle assigned and applied to each silo; two reentry vehicles assigned and applied to each silo to account for weapon system reliability only; and two weapons assigned and applied to each silo to compound damage. Each scenario is independently executed for each opposing force in a first strike mode.

COMPUTER INFORMATION: The program is written in FORTRAN and is currently operating on the AF MULTICS computer.

DOCUMENTATION: Users and programmers documentation is completed and is available at AF/SASM

NAME STRAT DUELER BRAVO

DESCRIPTION: STRAT DUELER BRAVO is a Monte Carlo trench system analysis model. The methodology is as follows: The trench is depicted as a line at user-specified hardness factors. The line starts at grid coordinates (0,0) and extends along the positive X-axis. The line is sub-divided into a user specified number of segments (max of 20), and in each simulation, a random point within each segment is sampled for its probability of survival (PS). The PS is evaluated against all user specified weapons attacking the trench which impact within 1.8 weapon radii of the randomly selected point in the selector, based upon the weapon's circular error probability (CEP). If the weapon is within 1.8 weapon radii, then the probability of surviving the detonation is given by the circular coverage function approximation:

$$1-(\text{Reliability})\left[e^{-.77\left(\frac{\text{Dist}}{\text{Weapon Radius}}\right)}\right]^{5}$$

After all points are evaluated against all weapon impacts, the PS value is computed as a function of trench remaining and overall trench length. The resulting PS is then multiplied by the number of systems in the trench to determine the number of surviving trench-based systems.

A limitation of this model is the trench damage function, which is an approximation. Also, the routine does not consider fratricide or RV impingement. These are factors that require future evaluation.

COMPUTER INFORMATION: The program is written in Fortran and is currently operating on the AF Multics computer.

DOCUMENTATION: Users and programmers documentation is completed and is available at AF/SASM.

1 9 JUL 1979

NAME: STRAT EXCHANGER

DESCRIPTION: The program is a strategic exchange analysis tool which calculates basic measure of merit for United States and Soviet ICBM and SLBM forces in counterforce strikes only. The measures of merit, upon which allocation and output can be based, include: (strategic nuclear delivery vehicles, reentry vehicles, throwweight, megatonnage, equivalent megatonnage, hard target kill potential, and counter-military potential.

The model can be run for each of three independent scenarios: one round attack, two round attack considering fratricide, and two round attack compounding the damage effects. The model executes under the desired scenarios for those years which the user selects. A launch-under-attack option is available and retargeting by the retaliator is permitted by the input parameters.

COMPUTER INFORMATION: The program is written in FORTRAN and is currently operating on the AF MULTICS computer.

DOCUMENTATION: Not currently available.

24 JUL

NAME: STRAT RANGE

DESCRIPTION: STRAT RANGE is a range/payload program to calculate the range of strategic aircraft on a variety of mission types. It is intended for calculating the range of existing aircraft for which performance data are readily available, and for aircraft in the design state for which performance data have been estimated.

Aircraft performance data (e.g. fuel used during climb, cruise, etc.) are supplied to the computer program in the form of regression equations. The mission characteristics are supplied in a series of input cards which describe the nature of the mission from the first flight segment through the last flight segment in the same order as they would actually be flown. Calculation of desired mission characteristics such as radius or range of a particular flight segment is achieved by specifying certain calculation options which govern the order in which flight segment calculations are made. The model also incorporates a routine to determine the number of tankers necessary to supply a given fuel offload to a stipulated bomber type.

COMPUTER INFORMATION: The program is written in FORTRAN language for time-sharing processing on the G-635 computer.

DOCUMENTATION: The program was completely revised during December 1974. Documentation is available in AF/SASB.

20 JUN 1979

NAME: STRAT SIZE

DESCRIPTION: STRAT SIZE is a force sizing equation used to determine the number of aircraft necessary to maintain a given number of patrol stations for a specified threat duration. The force size required to man a given number of patrol stations is a function of factors beyond initial station manning, i.e., reliability, aircraft endurance, duration threat, station distance from base, and the station relief concept. These factors are included in the force sizing equation. The model is generalized and has been used to determine the AWACS force required to man various barriers for CONUS defense as well as the interceptor force required to man various numbers of Strategic Orbit Points (STOP).

COMPUTER INFORMATION: This model was initially programmed on JOSS. It has been converted to FORTRAN IV for use on the G-635 time-share.

DOCUMENTATION: Draft documentation for STRAT SIZE is available in AF/SASI.

NAME: STRAT SPLASH

DESCRIPTION: The STRAT SPLASH model enables the user to estimate the single shot probability of kill (SSPK) for air-to-air missiles. While the missile aerodynamics form a significant portion of the model, the distinctive feature is the capability to estimate the effect of noise or deception ECM on missile guidance. The model incorporates an Army Materiel Systems Analysis Activity (AMSAA) terminal effects model to evaluate the interaction of warhead lethality and target vulnerability.

COMPUTER INFORMATION: STRAT SPLASH is written in FORTRAN IV program language. The IBM 360/75 is used for the model on a batch process basis. Run time is about nine times real time. Core storage requirements is presently 350K on the IBM 3032 computer.

DOCUMENTATION: Documentation for STRAT SPLASH is available in AF/SASI.

24 JUL 1979

NAME: SURVIVAL OF ALERT AIRCRAFT FROM SLBM ATTACK (STRAT SURVIVOR)

DESCRIPTION: STRAT SURVIVOR is a detailed simulation model of ground alert aircraft escaping from a pattern attack by submarine-launched ballistic missiles. The model uses simplified descriptions of aircraft performance and vulnerability, and relatively comprehensive damage algorithms based on the DIA Physical Vulnerability Handbook equations, the cumulative log normal distribution, and algorithms developed by Air Force Weapons Laboratory. The potential kills are summed and weighted to form an aggregated value matrix. The optimum weapon allocation is then selected using a standard transportation problem solution technique in a combination of base-by-base and missile round-by-round optimization. The model will allocate multiple missiles on a target when feasible and profitable. Inputs include aircraft characteristics and threat data (types and locations of submarines) and some offensive and defensive tactics data. The beddown can be scenario optimized if desired. The outputs are summarized by individual aircraft, by aircraft type, by base, and by submarine. Optional outputs include the peak overpressure and thermal levels experienced by individual aircraft and plots of aircraft paths and weapon DGZs.

STRAT SURVIVOR was developed in 1972 by the Assistant Chief of Staff, Studies and Analysis (AF/SA), and is used extensively to support studies of bomber pre-launch survivability.

COMPUTER INFORMATION: STRAT SURVIVOR was written for the G-635 computer in FORTRAN IV and GMAP. It is now being run on the IBM 370/3032. The model has been run successfully on the Honeywell 6080 by HQ SAC. There are approximately 11000 source statements; one control routine, and 100 subroutines in the model. The runtime for a case involving 20 submarines and 60 bases varies from 10 to 25 minutes depending on the tactics employed. The core requirements are 64K 36-bit words of storage.

DOCUMENTATION: Documentation available in AF/SA consists of a draft Program Documentation and a scripted briefing of the STRAT SURVIVOR Methodology.

2? ... 1979

SECTION C

MOBILITY

NAME: AIRLIFT LOADING MODEL (ALM)

DESCRIPTION: The ALM is an automated model that simulates the loading of military vehicles into cargo aircraft. It determines the loadability of vehicles both through the aircraft door and in the aircraft cargo compartment. Loading begins at the foremost left-hand corner of the cargo compartment with the widest vehicle that fits. Loading proceeds left to right, fore to aft in the compartment, always with the widest vehicle that fits the gap to be loaded. Loading priorities are based on grouping any number of vehicles in units of any size. The loading of troops and palletized cargo can also be accommodated by the model, but is secondary to the loading of military vehicles. The model will also sort vehicles on length, width, height, and weight parameters. The maximum number of vehicle types is 1,000 and the maximum number of aircraft types is five.

The ALM was developed in 1971 by the Assistant Chief of Staff, Studies and Analysis (AF/SA), Headquarters United States Air Force. It is based largely on its predecessor: A Program for Simulating the Loading of Aircraft with Military Cargo (SLAM) which was developed by the Boeing Company in 1964.

COMPUTER INFORMATION: The ALM was written for the G-635 computer system in the FORTRAN IV programming language. The model uses 60K words of G-635 core storage and consists of one control routine and 28 subroutines. There are approximately 4500 FORTRAN IV source statements in the model. The average running time is 10 minutes of processing time on the G 635. As of August 1978, the ALMs model is operational on the MULTICS system and is being used by OSD and JCS personnel for loading analyses.

DOCUMENTATION: The three documents in the ALM documentation series are Volume I, User's Manual; Volume II, Program Maintenance Manual; Volume III, Program Source Listing. Documentation is available in AF/SAMC.

2 4 JUL 1979

NAME: AIRLIFT VEHICLE ALLOCATION PROGRAM (AVAP)

DESCRIPTION: The Airlift Vehicle Allocation Program simulates an airlift network and can be used for force sizing or to analyze a fixed fleet of aircraft. The model accepts inputs of jobs to be done, aircraft characteristics for up to five aircraft, utilization rates, airfield data, and certain operational constraints (i.e., crew duty day). Output includes a detailed day's history of each airplane and a list of unsatisfied demands. In both the force sizing and fixed fleet versions, AVAP determines reasonably efficient beddown locations for the airlift force.

COMPUTER INFORMATION: AVAP is written in FORTRAN language for the G-635 and MULTICS computers. It uses approximately 60K words of core storage and requires about an hour to accomplish the airlift demands for one day of a NATO contingency.

DOCUMENTATION: A Programmer's Manual and a User's Manual are available in AF/SAGM.

2 4 JUL 1979

NAME: INTERACTIVE STRATEGIC DEPLOYMENT MODEL (ISDM)

DESCRIPTION: The Interactive Strategic Deployment Model (ISDM) is a computerized heuristic programming algorithm for solving the problem of the allocation and scheduling of resources to deploy forces in a military contingency operation.

The objective of the ISDM formulation is to minimize the time to deploy the forces available each day subject to constraints on the amount of airlift and sealift capability available, on preferred movement orders of forces (priority), on maximum and minimum convoy sizes, and on acceptable levels of risk of attrition by enemy submarines.

ISDM has been designed to be a part of a system of programs which handles information storage and retrieval for force list data bases and generates tables and reports about the forces.

COMPUTER INFORMATION: The ISDM algorithm is programmed in FORTRAN on the MULTICS computer and potentially uses up to two million words of storage. The program runs in one to five minutes of CPU time.

DOCUMENTATION: Documentation is being accomplished by General Research Corporation who developed the model under an OSD/PA&E contract.

24 JUL 1979

NAME: RECEIVER ONE

DESCRIPTION: The model was developed to evaluate the reception capability of the major aerial ports of debarkation (APOD) in NATO. It permits interaction of seven air base segments with their environment. It measures the number of preplanned sorties and their tonnage delivered to or diverted from each base.

RECEIVER generates an aircraft at high-station and places it in the holding pattern. The aircraft penetrates, lands, and taxis into a parking space on the ramp. At APODs near the battle area, aircraft is offloaded and reconfigured for departure to a recovery base for refueling for the return flight to the CONUS. The rear location APODs offload and refuel the aircraft.

Delays are measured by the amount of time spent in queues for approach phase, ramp space, aerial port servicing, and the runway upon departure. Imbalances in APOD resources are identified by the relative size of the queues developing during the execution phase.

The model may be changed for weather conditions, enemy interdiction rates, air base loss, competing traffic, attrition, and flow rate. It is possible to expand the model to a total of 99 APODs.

COMPUTER INFORMATION: Operates on Honeywell or IBM computers equipped with a GPSS V compiler.

DOCUMENTATION: Available in SAMC and SAGM.

2 4 JUL 1979

NAME: TACTICAL AIRLIFT SYSTEM SIMULATION MODEL (TASSM)

DESCRIPTION: The Tactical Airlift System Simulation Model evaluates the ability of an airlift force to accomplish intratheater movement of troops and cargo.

The model determines movement requirements from source to destination bases based upon troop strength, force posture, consumption rates and estimated percentages of the amount of total cargo and troops that will be airlifted. A portion of the movement requirements are directed from source to destination. The remaining demands are satisfied by solution of a transportation problem, minimizing the distances from sources to destinations. An aircraft performance module calculates the allowable cabin load (ACL) for each source-destination pair. Pallet distributional data for the types of units located at each destination is then used to determine the amount of payload delivered on each mission.

The model can accommodate a maximum of five different aircraft types at one time. Output consists of the number of aircraft required to fulfill all airlift demands each day, the total tons hauled and the fuel used to each base each day.

COMPUTER INFORMATION: TASSM is written in the FORTRAN language for the G-635 computer. It uses approximately 65K words of core storage and requires about an hour to accomplish the workload for 20 days of a NATO contingency operation.

DOCUMENTATION: Documentation is in two volumes; Volume I, User's Manual, and Volume II, Programmers Manual. Documentation is available in SAMC and SAGM.

NAME: VEHICLE LOADING MODEL (VLM)

DESCRIPTION: The McDonnell Douglas Vehicle Loading Model (VLM) was developed to provide the means to quickly analyze the interactions of unique aircraft characteristics with diverse movement conditions, fleet mixes, load strategies, and movement requirements.

The VLM is a computerized model for loading military units consisting of men, vehicles, and non-mobile equipment on airlift aircraft. The user of the VLM has the unique capability of controlling the loading process to any level of detail desired; from general guidance to detailed type loads. This control is exercised via input of multi-dimensional vehicle loading rules that identify vehicles by their generic dimensional characteristics. In addition, the user may select combat, tactical, strategic, or administrative loading, request dynamic offload of cargo or ammo from vehicles onto 463L pallets, save intermediate results for later processing, and select from over 25 different output reports. Extensive free-form input is provided.

The capabilities described in this report may be used to determine the requirements for new or modified aircraft designs, as well as to load and evaluate existing airlift aircraft.

COMPUTER INFORMATION: VLM is a computerized model written in FORTRAN IV and IBM 360/370 ASSEMBLER language, and designed to operate under OS 360/370 and MULTICS computers.

DOCUMENTATION: Documentation is in the form of a User's Guide and a Programmer's Guide and is maintained in SAMC and SAGM.

24 JUL 1979

SECTION D

OTHER

NAME: RELEVANCE VALUES (RELVAL)

DESCRIPTION: The RELVAL model is used to rank study programs in priority order, to determine the cost-effectiveness of each study program, and to provide other quantitative analyses useful to a decision-maker during management surveys. The basic methodology used in PATTERN (Planning Assistance Through Technical Evaluation of Relevance Numbers). PATTERN uses a systems approach to analyze a problem, which includes a tree-like structure called a "Relevance Tree" where each objective is part of a larger objective. Relevance numbers are assigned to each division point and the relevance number of each task is computed by considering the weights at each hierarchal level. Model inputs required include: (1) a listing of Air Force issues; (2) a listing of study programs; (3) a listing of functions involved. The decision-maker is required to fill out a questionnaire assigning weights to issues, functions, and to programs within the context of issues and functions. RELVAL then calculates the ranking of programs and assigns a relevance (relative importance) number to each program. The present output includes: (1) a program priority listing by relevance number and histogram for each program; and (2) a program priority listing by cost effectiveness value (manpower per relevance number) and histogram for each program.

The output of RELVAL provides a quantitative tool to guide the decision-maker in ranking programs during management surveys.

COMPUTER INFORMATION: The RELVAL model is currently exercised on the G-635 time-share computer system.

DOCUMENTATION: Documentation is maintained in AF/SAGP.

2 8 JAN 1979

NAME: Son of Super ACE (SOSAC)

DESCRIPTION: SOSAC is a linear programming, weapon allocation model which calculates traditional target damage as well as Relative Force Size. The model applies an arsenal of weapons against a target base comprised of installations which have been aggregated into "aim areas. The model is completely dependent on the target base format, and it is precisely the partitioning and aggregation of the target base that is instrumental in determining the fidelity of the results. SOSAC was developed by SAI for OSDPA&E.

COMPUTER INFORMATION: SOSAC is currently running on the AF/DSC MULTICS Computer.

DOCUMENTATION: Minimal formal documentation exists. This documentation is available in OSDPA&E.

NAME: WRECS VI, A FORTRAN CODE FOR COMPUTATION OF WEAPON RADIATION EFFECTS ON COMMUNICATION SYSTEMS

DESCRIPTION: WRECS VI estimates nuclear weapon induced degradation of VLF, LF and HF radio trunks. Computation procedures allow efficient treatment of multi-burst, multi-trunk problems. The inputs include weapon and trunk information, evaluation times, and user options. Weapons are characterized by yield, location, detonation altitudes, fission fraction, and detonation time. Radio trunks are characterized by operating frequency(s), terminal locations, and operating signal strength margin. Also, HF trunk descriptors include antenna type, transmitter power and bandwidth. Normal output is trunk status and estimated dB change in signal level at each time.

COMPUTER INFORMATION: WRECS VI has been run on the G-635 and the H6080 for TS data. Core requirements are 45K in linked version and 150K total. Run times vary from 15-20 minutes for a few links and a few bursts to 5 to 10 hours for tens of bursts and hundreds of links.

DOCUMENTATION: Three volumes, a user's manual, a description of the computational models, and a description of computer routines are available from DCA or from AF/SASC. The tape is on file in the AFDSC library.

20 JUN 1979

SECTION E

UNDER DEVELOPMENT

NAME: PERS ANALYZER

DESCRIPTION: The PERS ANALYZER model simulates the career movement of rated officers in accordance with input personnel policies and decisions. It provides a predictive capability to examine short and long-term implications of rated personnel management options. On an annual basis, the model accounts for retention and loss, promotion, assignment, force augmentation and UPT accession. Manpower slots are evaluated and made available in the order of a user input priority. Persons are considered for each slot vacancy on a priority basis using such criteria as weapon system, years' service, flying time, AFSC, etc. The output information includes inventory by weapon system, years of service and grade; total experience by weapon system; UPT graduates by weapon system; number of officers filling RPI coded slots and AFIT/PME positions; losses to the force by weapon system, "GATES" status data; and other career pattern data.

PERS ANALYZER development was begun in March 1977 and is expected to be complete by 1 October 1979.

COMPUTER INFORMATION: PERS ANALYZER was initially written for the G-635 Computer, GECOS III, in FORTRAN IV. It is being transferred to the IBM 3032 computer and envisioned to be transferred to the Burroughs B6700 in the near future.

DOCUMENTATION: Documentation currently consists of a draft Users' Manual including descriptive notes on most of the subroutines.

19 JUN 1979

NAME: RECEIVER TWO

DESCRIPTION: This model is an expansion of RECEIVER ONE. It receives the cargo delivered by strategic airlift to the APODs and generates tactical airlift sorties to forward the cargo to its final destination. It contains eight strategic interface APODs and 40 tactical airlift bases. The model accumulates statistics on cargo delivered as a percentage of cargo movement requirements, aircrew duty day, aircraft utilization rates, and facility usage.

Development began in May 1978 and is continuing.

COMPUTER INFORMATION: Requires a GPSS V compiler in a Honeywell computer.

DOCUMENTATION: Available in SAMC.

2 4 JUL 1979

NAME: STRAT MISSILER

DESCRIPTION: STRAT MISSILER is a system of analytical computer models and related software elements designed to address a wide range of strategic missile (ICBM/SLBM) issues. These analytical models are capable of evaluating both current and future missile forces (red and blue) and their basing modes. The comprehensiveness of the model permits consideration of many real world constraints including missile performance, defense attrition and nuclear effects.

As currently designed, STRAT MISSILER consists of six major subsystems and is modular in structure. The Accessibility and Model Data Generation subsystem are stand-alone preprocessors that generate initialization data required by other modules. Accessibility produces ballistic missile system performance data (e.g. maximum range, minimum range, and footprint dimensions) and Model Data Generation treats mobile-based missile systems.

Three subsystems (Allocation, Assignment, and Scheduling) are used to construct red or blue strategic plans. These elements produce timed laydowns of strategic missile forces covering the current and anticipated spectrum of nuclear warfare. These subsystems are detailed sufficiently to allow treatment of strategic missile physical constraints.

The last subsystem, Analysis, evaluates the strategic plans by computing measure of effectiveness such as damage expectancy, collateral damage and target coverage. Additionally, this module evaluates weapon attrition caused by pre-launch attacks, nuclear effects during booster flight, defense interception and terminal reentry vehicle fratricide.

COMPUTER INFORMATION: STRAT MISSILER is compatible with IBM 370 like computer systems and is coded in FORTRAN and COBOL languages.

DOCUMENTATION: Complete user's and maintenance documentation is available in AF/SASM and AF/SAMC.

2 4 JUL 1979